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ABSTRACT

The purpose of this study was to develop a Framework for Performance Assessment in Science Education (F-PASE). Science educators in the past have paid more attention to science curriculum and teaching strategies than assessment. In recent years attention has turned toward performance assessment which addresses the concerns of science curriculum and instruction and which is consistent with goals of science education at various levels of interests. Science educators are trying to do performance assessment, yet they don't have a highly qualified framework in terms of science educational objectives for the future and advantages of performance assessment. The paper has developed a framework for performance assessment in science education, which may be useful for science teachers to understand and assess their students' abilities. Seven domains, covering students' various abilities, are the important objectives of science performance assessment and can be grouped into three categories: General, Science specific, and Intermediate abilities. A F-PASE, with three dimensional solid figured structure, was developed and illustrated as the configuration of a corn. F-PASE is useful for science teachers to develop and select a science performance assessment as well as have a more advanced understanding of their students' abilities. It is a creative and novel assessment framework in terms of a structure, a configuration, functions and meanings. It also suggests a new vision of an assessment framework in science education. (Contains 16 references.) (Author/CCM)

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Developing A Framework for Science Performance Assessment

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ABSTRACT

The purpose of this study is to develop a Framework for Performance Assessment in Science Education(F-PASE). Science educators in the past have paid more attention to science curriculum and teaching strategies than assessment. In recent years attention has turned toward performance assessment which addresses the concerns of science curriculum and instruction and which is consistent with goals of science education at various levels of interests. Science educators are trying to do performance assessment, yet they don't have a framework highly qualified in terms of science educational objectives for the future and advantages of performance assessment. We, therefore, have developed a framework for performance assessment in science education, which may be useful for science teachers to understand and assess their students' abilities

We have extracted seven domains covering students' various abilities as the important objectives of science performance assessment and grouped them into three categories: General, Science specific, and Intermediate abilities. And we developed a F-PASE with three dimensional solid figured structure, and illustrated it as the configuration of a corn. F-PASE is useful for science teachers to develop and select a science performance assessment as well as have a more advanced understanding of their students' abilities. It is creative and novel assessment framework in terms of a structure, a configuration, functions and meanings. It also suggests an new vision of an assessment framework in science education.

Introduction

Assessment is an integral part of science education (Glattorn, 1998). That is, all teachers are concerned with what and how their students are learning and doing, and must do something for keeping track of students' progress. Despite the reality that educators need a better method for assessing the progress of students' learning and their abilities, few guidelines have been developed for this. This has resulted in educators' reliance on standardized testing, which usually employs multiple choice or mathematical problem solving formats. And while it may be true that most formal standardized tests adequately assess students' understanding of scientific knowledge, unfortunately it does not serve well to assess students' abilities, such as use of process skills and problem solving strategies.

In Korea, science educational assessment paid much attention to a kind of high stakes assessment as standardized test of multiple choice items in the past, but recently many attempts about alternative assessments,

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especially performance assessment are done all over the nation.

Based on the theoretical backgrounds of constructivism, cognitive psychology and motivational psychology, the value of performance assessment is confirmed in science education (Phillips,1997; Roth,1990; Driver,1986; Resnick,1989; Glaser,1984; Baron,1991). Performance assessment not only involves the methodology of unifying teaching, learning and assessment, but also involves the intermediate area which lies between actual classroom experience and theories (Baron, 1995; Berk, 1986; Champagne, Lovitts, & Calinger, 1990; Wiggins, 1993; Wolf) However, it is hard to administrate a science performance assessment in practice in concord with theoretical perspectives(Lim et al,1999; Kim, 1998). Here, a framework is needed to connect these theoretical backgrounds with it's practices in actual science classroom.

The purpose of this study is to develop a framework for performance assessment in science education(F-PASE)which may be useful for science teachers to understand and assess their students' variable abilities. It will help teachers, students, parents, any other educational staffs and authorities to have a consensus of the procedures and results of performance assessment in science education.

Rationale for the Study

1) *Framework for performance assessment in science education(F-PASE) based on constructivism, cognitive psychology and motivational psychology*

The development of F-PASE, as viewed through three perspectives, makes three important points.

First, there is the need to recognize active, rather than passive nature of students' learning.

Second, an instruction must provide information for students' knowledge construction processes as well as adapt to developmental shifts in students' learning.

Third, assessment must involve monitoring and feedback implement about students' learning processes and abilities.

2) *Problems on applying previous assessment framework to performance assessment in science education.*

The Previous assessment framework is used for two purpose in science education. One is for diagnoses teaching-learning and feedback in the educational aspect, for example, Bloom's taxonomy or Klopfer's, which

has two dimensions, content and action (Kim et al, 1991). The content dimension could be assigned the one of scientific domains such as scientific knowledges and attitudes. The other is for making items of large-scale examinations administrated socially or nationally, for example, of APU's(Assessment of Performance Unit's in UK), which have three dimensions (three axes) of scientific knowledges, scientific inquiry thinking and contexts(Kim et al, 1991).

Both have views of behavioral psychology and f quantitative evaluation with psychometry. Also, they pursue analytic assessments.

However, F-PASE is completely different from the previous framework mentioned above in terms of the perspectives it is based on. That is, F-PASE has learning view of cognitive psychology and qualitative assessment based. Also, it pursues a holistic assessment.

Hence, the previous framework cannot be adopted any more.

Research Methods and Procedures

We have continuously conducted literature reviews and team discussions about science education goals for the future, the advantages of performance assessment and the need of a new framework for performance assessment in science education.

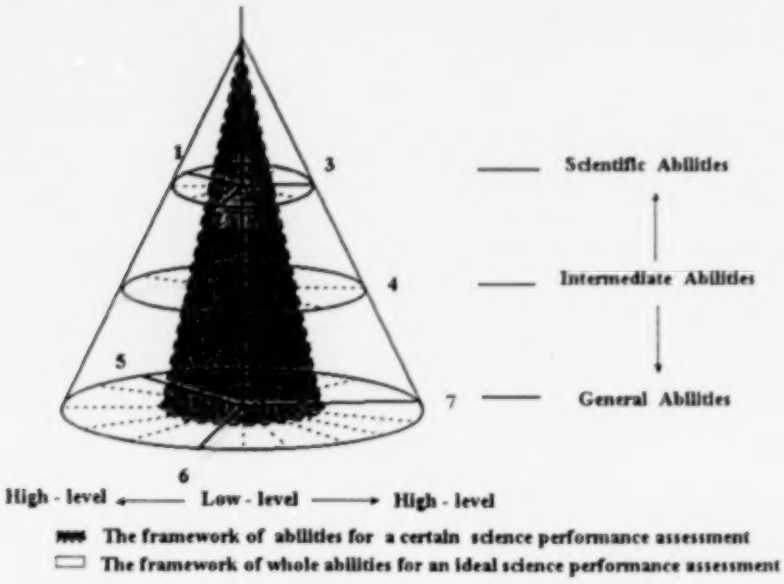
We have discussed characteristics of performance assessment and analyzed previous assessment frameworks for developing F-PASE.

We have extracted 7 assessment domains and their subordinate components for F-PASE. And they are categorized in 3 groups according to the extent of relations with the nature of science.

Moreover, we have developed F-PASE shaped like a cone, which has special meanings of directions, up-down and center-edge.

Finally, we drew the conclusions about the significance and suggestions of this framework in science education.

The Framework for Performance Assessment in Science Education (F-PASE)



<Fig.1> The configuration of F-PASE

Seven domains and their subordinate components are selected for F-PASE. They are constructed in the configuration of a corn (Fig 1).

Seven domains are grouped in three categories according to the extent of relations with the nature of science. These seven are grouped into three categories: scientific abilities and perspectives; general abilities; and intermediated abilities. Like fig.1, the three categorized groups are placed vertically.

General abilities are placed at the bottom, scientific abilities at the top and intermediate abilities in the middle.

And the domains and their subordinate components are places like ribs of a fan(Fig.1).

In figure 1, the solid line represents the ideal maximal point (infinite quality) of abilities that science performance assessment is intended to, and the dotted line represents a certain science performance assessment is intended to assess. In other words, the large transparent cone is the highest (the ideally largest) framework that represents all of abilities that a science performance assessment could have, and the small inner cone is the framework that a certain science performance assessment shall have.

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The seven categorized domains are as follows;

1) The Domains of Scientific Abilities and Perspectives

(1) *Scientific Attitude: The value, attitude and emotion related to science*

· Curiosity (Interests) · Rationality · The pause of judgment · Modesty · Openness

· Criticism · Objectivity · Honesty · Awareness of limits of scientific knowledge

(2) *Scientific Inquiry Thinking*

· The abilities of beginning inquiry: Awareness of problems, Hypothesis formulating

· The abilities of designing inquiry: The Control of variables, Experimental design,

· The abilities of performing inquiry: Observation, Classify, Recording data, Inferring, Predicting

· The abilities of dealing data: Interpretation, Transformation, Analysis

· The abilities of generalization and evaluation

(3) *Scientific inquiry skill : This domain includes only manual skills.*

· Measurement · Dealing with experimental instruments · Using computer

2) The domain of intermediate abilities

(4) *Application of relevant scientific knowledge*

· The ability of selecting relevant knowledge to solve a problem

· The application of adequate concepts

3) The domains of general abilities

(5) *Communication*

· Informing others of one's own thought · Understanding of the others' thoughts

· Intervention of opinion: The ability of intervening in a dispute and carrying out an agreement.

· Visualization: The ability of presenting one's thought with visual aids to communicate with others

· Using of information: The ability of finding and using information and informing others of one's own ideas using various materials of electronic materials such as internet sites, and CD ROM as well as

related literature to communicate with others

(6) *Creative thinking*

- Sensitivity to problems
- Originality: The ability of thinking special ideas which are different from others
- Flexibility: The ability of thinking divergently
- Elaboration: The ability of thinking systematically and organizing thoughts.
- Fluency: The ability of thinking fluently. · Reorganization

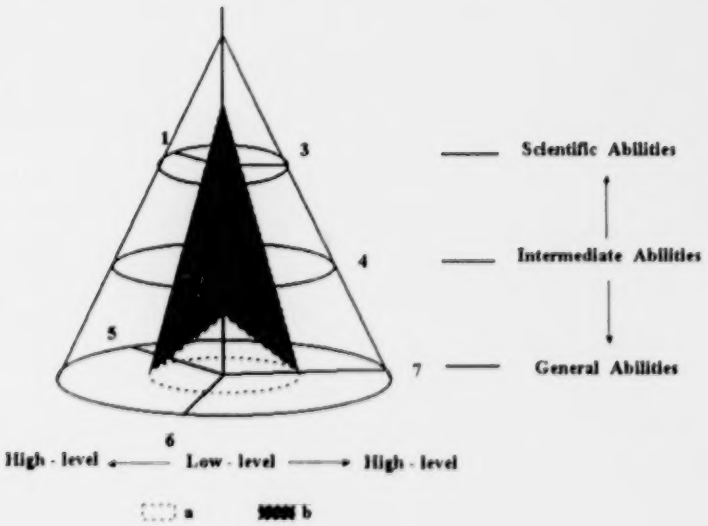
(7) *Reflective thinking*

- The ability of self-reflection · The ability of self-evaluation
- Constructing & producing new scientific knowledge through reflective thinking process

The Structure of F-PASE

1) Direction of F-PASE

(1) Up and Down



<Fig. 2> The configuration in the direction of up and down

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The direction of up and down is related to the extent of relevance in the nature of science. However, it dosen't mean that the general abilities on bottom are not scientific. Definitely, all abilities in this framework are scientific. That is, they are very usable abilities for scientific problem solving. Moreover, abilities of general domain have broader chances of applications, such as social domain, verbal domain, art field and etc., than scientific domains.

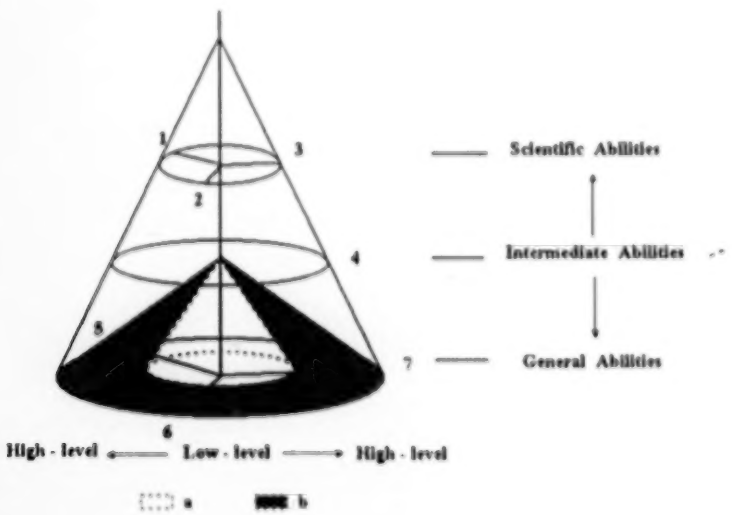
The figure 2 is illustrated as the configuration by the direction of up and down.

In figure 2, **a** represents the framework of a certain science performance assessment whose scientific abilities are less relevant than **b**. Hence, while **a may** be a framework for lower grade students, **b may** be the one for higher grade students.

(2) From the center to edge

The direction from the center to edge is related to the level of abilities in domains and their components. The closer to the center axis, the lower level of ability. On the contrary, the farther from the center, the higher level of ability.

The figure 3 represents the two cases which have the same relevant level in terms of scientific specificity but differences on ability level. **a** represents a case intended to assess lower level abilities than **b**.



<Fig. 3> The configuration in the direction from the center to edge

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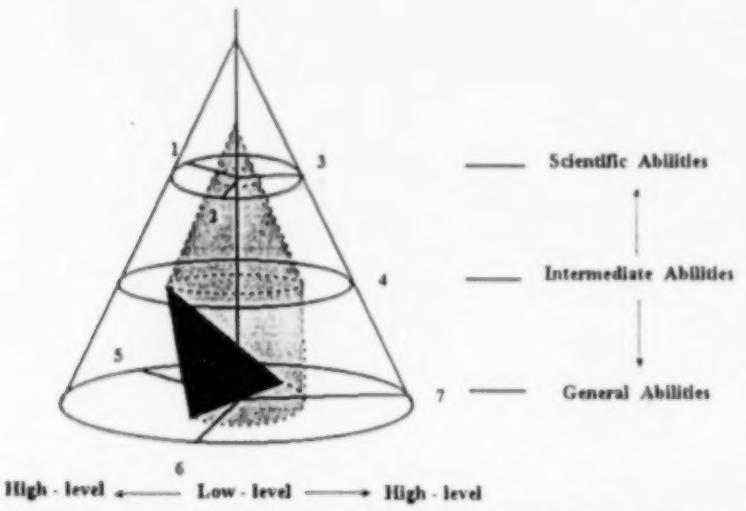
2) Shape

Every framework of science performance assessment dosen't have a cone shape. Rather, It is more felicitous that the cone shape is such an ideal form that a few might have a cone shaped framework.

The actual framework shape is represented so variously, according to what a science performance assessment is intended to assess. Figure 4 illustrates the shape of an example which has unbalanced assessment domains. In this figure, the domain 5 doesn't exist, and the domains 6 and 7 are lower than the others.



<Fig.4> An example of various shaped frameworks

3) Volume

The volume of the solid figure means the depth of science speciality and levels of assessed abilities in a science performance assessment. Figure 5 shows what the difference of the volume means, **a** in figure 5 is the framework of a science performance assessment for the early elementary school students while **b** is for science specialists.

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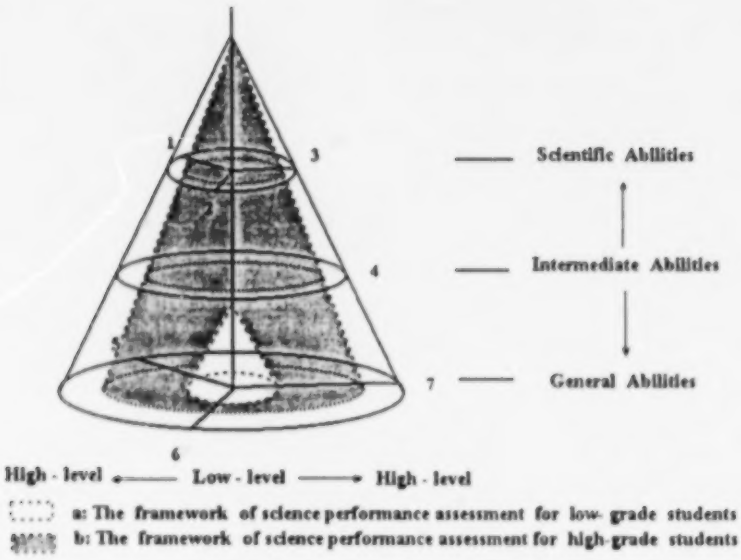
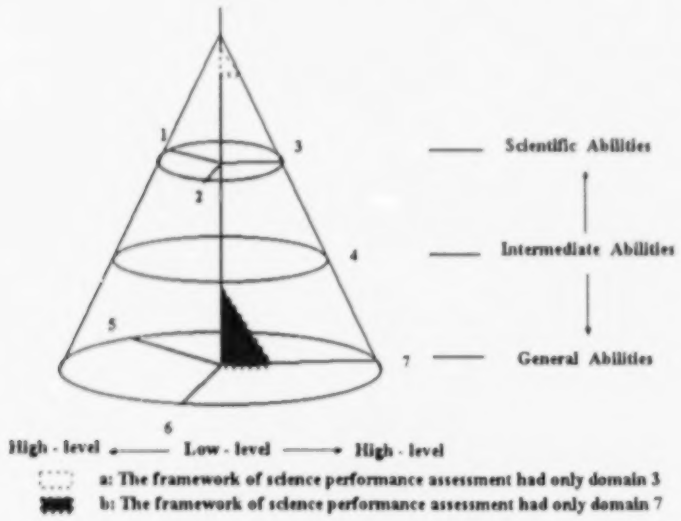


<Fig.5>The comparison of frameworks by the difference of the volume

4) Location

The location of a framework represents varieties of assessment domains. **a** in figure 6 offers a case intended to assess only domain 3, and **b** offers that of only domain 7.



<Fig.6> The meaning of the location of a framework

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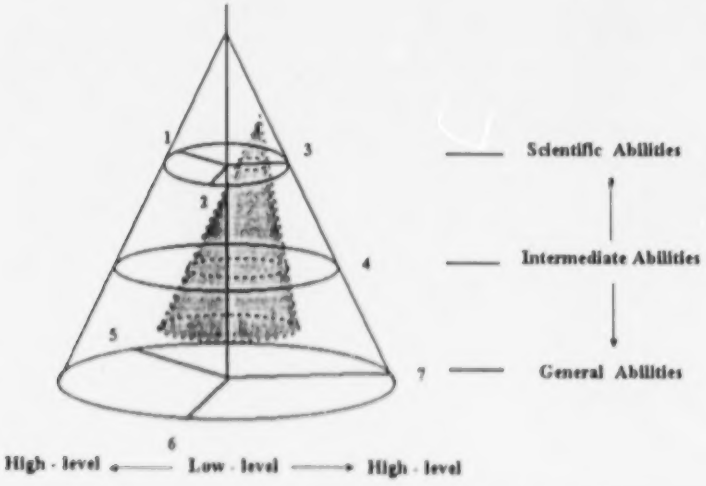
5) Angle of center axis

Angle of center axis means the balance among the assessment domains. Figure 7 shows a framework where domain 1 isn't included.



<Fig.7> A framework which has inclined center axis

The Strength of Framework for Performance Assessment in Science Education(F-PASE)

First, F-PASE is focused on students' competencies (abilities) for a task, while previous frameworks are focused on scientific knowledge in problems.

Second, in F-PASE, multi-domains is considered as a whole (Chittenden, 1991; Lazzaro & Park, 1994; Meisels, 1993; Perrone, 1990; WCEA, 1993; Herman, et al., 1992) and they are built into a solid body as a cone.

On previous frameworks, there are two dimensions of contents and actions;, the action might be one of domains, such as cognitive domain, affective domain and psychomotor domain and the contents are scientific knowledge.

Such assessment administrated by the frameworks limit to understand of students' learning and abilities.

Third, F-PASE has included students' various abilities assessed by performance assessment. The abilities will help students prepare for the 21st century.

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Fourth, F-PASE shows the relative position of a cetain science performance assessment in the ideal framework.

Conclusions and Educational importance

This framework would give us a new vision about a framework in learning and teaching science. This framework is a creative and novel product.

In addition, it will be a useful tool for science teachers to understand and assess their students' variable abilities. This will help science performance assessment come true in science education.

References

Baron, B. J. (1991). Performance assement: Blurring the edges of assessment, curriculum, and instruction. In G. Kulm & S. M. Malcom (Eds.), Science Assessment in the Service of Reform, pp. 246-266.

Berk, R. A. (1986). Performance assessment: Methods and applications. Baltimore, MD: Johns Hopkins University Press.

Birenbaum, M. (1996). Assessment 2000: Towards a pluralistic approach to assessment. In M. Birenbaum & F. J. R. C. Dochy (Eds.), Alternatives in assessment of achievements, learning processes and prior knowledge (pp. 3-29). Norwell, MA: Kluwer Academic Publishers.

Bloom, B., Hastings, J., & Madaus, G. (1971). Handbook of formative and summative evaluation of student learning, New York, NY: McGraw-Hill.

Chittenden, E. (1991). Authentic assessment, evaluation, and documentation of student performance. In V. Perrone (Eds.), Expanding student assessment. Alexandria, VA: Association of Supervision and Curriculum Development.

Driver, R. (1989). Students' conceptions and the learning of science. International Journal of Science Education, 11, 481-490.

Glatthorn, A. A., Bragaw, D., Dawkins, K., & Parker, J. (1998). Performance assessment and standards-based curricula: The achievement cycle. Larchmont, NY: Eye On Education.

Kim, Y. S. (1998). Qualitative Research of Science Performance Assessment in Korea. Unpublished Master thesis at Korea National University of Education.

Kim et al (1991). Science Learning Evaluation, Seoul; Educational Science Publisher.

Lim, Y., Cho, H., Hann, A., Park, H., Song, M., Kim, E., Hong, S., Kang, H., & Noh, S. (1999). Survey on authentic performance assessment for elementary science education, Journal of elementary science education, 18(1), 41-51.

Glaser, R. (1984). Education and thnking: The role of knowledge. American Psychologist, 39, 93-104.

Phillips, D. (1987). Socialization of perceived academic competence among highly competent children. Child Development, 58, 1308-1320.

Resnick, L. B. (1989). Knowing, Learning, and Instruction: Essays in Honor of Rober Glaser, Hilsdale, NJ: Eribaum.

Roth, W. M. (1995). Authentic school science. Dordrecht, Netherlands: Kluwer Academic Publishers

Wiggins & Grant (1993). Assessment: Authenticity, context and validity. Phi Delta Kappan, 200-214.

Wolf, K. (1994). Teaching portpolios: Capturing the complexity of teaching. In L. Ingvarson & R. Chadbourne (Eds.), Valuing teachers' work: New directions in teacher appraisal, Australian Council for Educational Research, Melbourne, Australia, 112-136.